(D) Remarks

1. Amendment to page 19 of the Specification is requested to correct a typographical error.

2. Rejection Under 35 U.S.C. 103(a)

In the Office Action, claims 1-63 were rejected under 35 U.S.C. 103(a) as being unpatentable over the article to William Wescott et al. titled "Modern applications of biostratigraphy in exploration and production".

In the Office Action it was also stated that:

"The features of the claims directed to processing and presentation of seismic data are not seen to be supported as being any different than that already notoriously well known within the seismic data processing arts. Nor does applicant's own disclosure give such criticality and novelty to such seismic data processing features. The gist of the inventive difference with respect to the prior art is the choice of how the substrata/subsurface region earth model references strata regions by use of geologic age (i.e. nebulous and poorly claimed concept " geologic time volume' " which could be read on other unintended concepts such as any well known seismic data volume/voxel since seismic echoes have a travel time from the reflected geologic region) and the correlation of geologic age with the modeled seismic data points/regions.

`The Wescott et al. article teaches the use of such geologic age referencing and correlation with seismic data models. While the article does not disclose explicit details of the internal computer structure (e.g. "storage locations", memory, etc.) and its data processing steps, those skilled in the art would understand and would have known that such operational features were inherent or routinely carried out in the art to support the operational functions discussed in this article. In light of the teachings of this and other art of record, to use geologic time era information in the description of subsurface strata regions and with geologic models including seismic as well as with other types of sensed and gathered

subsurface data, e.g. wellbore data of various types, and incorporating such into the geological model. Therefore, the standard prior art data fusion techniques would inherently include along with the use of "geologic times" data the remaining well known seismic data processing techniques into such models, such as interpolation, 2D and 3D modeling techniques, etc. Also note that claims directed to the various computer storage medium and software support structure would thus also be inherently used in such computer systems as this article would use support its taught modeling functions, and note that applicant's own disclosure teaches at the same level of disclosure of this article namely fails to teach anymore than direction to use such products – applicant has not disclosed any program code nor algorithm flowchart to support development of such an enabling computer program on any type of notoriously well known computer storage memory device.

The rejection of the claims under 35 USC 103(a) is respectfully traversed.

The Wescott et al. article discloses the correlation of two vertical geologic time columns using a graphic correlation method. The process of graphic correlation involves either crossplotting two stratigraphic sections of similar age on x,y coordinates and projecting the observed fossil ranges of both sections to a line of correlation (LOC) to make precise correlations, as shown in Figure 1a of the Wescott et al. article, or crossplotting the observed ranges of a single stratigraphic section against a database of composited fossil ranges scaled in chronostratigraphic units, as shown in Figure 1b. The article also shows how these geologic time columns, or biostratigraphic columns can be displayed on a seismic section to aid in the seismic event correlation. Figure 7 of the Wescott et al. article shows how relative geologic time can be directly tied to a seismic display to make more accurate interpretations. Figure 9 of Wescott et al. shows how paleontological data can be directly plotted on a seismic line in a work station to aid in interpretation.

However, with reference to claim 1, neither the Wescott et al. article, nor any of the other cited references, either alone or in combination, teach, disclose or suggest declaring a geologic time volume having data storage locations corresponding to substantially each of the seismic data sample points in a selected seismic data volume, obtaining a geologic time for substantially each seismic data sample point in the selected seismic data volume; and storing said obtained geologic times in said geologic time volume in data storage locations corresponding to substantially each seismic data sample point for which a geologic time was obtained.

With reference to other comments in the Office Action, Applicant disagrees with the view expressed in the Office Action that "a geologic time volume" is a nebulous concept. A rather specific definition of a geologic time volume is provided in the Specification on page 4, lines 3-17, as follows:

> **In accordance with the present invention, a geologic time volume is generated in which the geologic times at which the sediment was deposited corresponding to the travel time (or depth) of the sample points of the seismic data traces of a seismic data volume are stored in memory locations on a data storage medium. The goal of generating a geologic time volume is to have a representation of geologic time for every sample point in a seismic data volume. . . . . The difference between the geologic time volume and the seismic data volume is that the value of the data point in the geologic time volume will be related to geologic time, rather than reflection amplitude (or other measured or calculated seismic attribute value).**

Applicant further disagrees with the view expressed in the Office Action that the claims are not directed to anything any different from that already notoriously known in the seismic arts. Applicant is not aware of anything in the prior art that teaches, suggests or discloses the invention and none has been cited in the Office Action. If this objection is maintained, the Examiner is

respectfully requested to cite references which show the subject matter of the claims.

Applicant further disagrees that a geologic time volume could be read on well-known data volumes. The difference between the geologic time volume and the seismic data volume is that the value of the data point in the geologic time volume will be related to geologic time, rather than reflection amplitude (or other measured or calculated seismic attribute value).

Further with reference to claim 21, neither the Wescott et al. article, nor any of the other cited references, either alone or in combination, teach, disclose or suggest selecting a plurality of identified horizons from said seismic data volume, assigning a geologic time to each said identified horizon; storing said geologic time assigned to each said identified horizon in storage locations in said geologic time volume corresponding to locations of said identified horizons in said seismic data volume; and further obtaining a geologic time for substantially each storage location in said geologic time volume for which a geologic time of said identified horizons has not been assigned and storing said obtained geologic time in storage location for which a geologic time of an identified horizon has not been obtained.

Further, with reference to claim 28, neither the Wescott et al. article, nor any of the other cited references, either alone or in combination, teach, disclose or suggest calculating instantaneous phase for a plurality of said seismic data traces; unwrapping the calculated instantaneous phase for said plurality of seismic data traces; assigning geologic times to locations along said seismic data traces, said geologic times being related to unwrapped phase at said locations; and storing said assigned geologic times in selected storage locations corresponding to said locations along said seismic data traces, to generate a geologic time volume.

Further, with reference to claim 41, neither the Wescott et al. article, nor any of the other cited references, either alone or in combination, teach, disclose or suggest a method for analyzing

seismic data, comprising selecting a seismic data volume comprising seismic data sample points; selecting a plurality of adjoining subvolumes from said seismic data volume; for each subvolume, obtaining geologic times corresponding to at least a portion of said seismic data sample points; reconciling geologic times corresponding to seismic data sample points in adjoining locations of said subvolumes; and for each subvolume, storing said reconciled geologic times in data storage locations corresponding to said at least a portion of said seismic data sample points; thereby generating a geologic time volume for each subvolume, as claimed in claim 41.

Further, with reference to claim 45, neither the Wescott et al. article, nor any of the other cited references, either alone or in combination, teach, disclose or suggest a method for analyzing seismic data, comprising selecting a seismic data volume comprising seismic data sample points; selecting a plurality of adjoining subvolumes from said seismic data volume; for each subvolume, obtaining geologic times corresponding to at least a portion of said seismic data sample points; reconciling geologic times corresponding to seismic data sample points in adjoining locations of said subvolumes; and storing said reconciled geologic times in data storage locations corresponding to said selected seismic data volume; thereby generating a geologic time volume

Claim 50 is similar to claim 1, except that it includes the additional step of applying data compression techniques to assembled geologic time data, thereby generating compressed geologic time data, and should be allowable for at least the reasons advanced with respect to claim 1.

Claim 58 claims a digital computer programmed to utilize seismic data to perform a process comprising the steps of claim 1 and should be allowable for at least the reasons advanced in respect of claim 1.

Claim 59 claims a device which is readable by a digital computer having instructions defining the process of claim and instructions to the computer to perform the process, and should

be allowable for at least the reasons advanced in respect of claim 1.

Claims 60 claims a digital computer programmed to utilize seismic data to perform a process comprising the steps of claim 21 and should be allowable for at least the reasons advanced in respect of claim 21.

Claim 61 claims a device which is readable by a digital computer having instructions defining the process of claim 21 and instructions to the computer to perform the process, and should be allowable for at least the reasons advanced in respect of claim 21.

Claim 62 claims a digital computer programmed to utilize seismic data to perform a process comprising the steps of claim 28 and should be allowable for at least the reasons advanced in respect of claim 28.

Claim 63 claims a device which is readable by a digital computer having instructions defining the process of claim 28 and instructions to the computer to perform the process, and should be allowable for at least the reasons advanced in respect of claim 28.

Dependent claims not specifically discussed herein should be allowable for at least the reasons advanced in respect of independent claims from which these dependent claims depend.

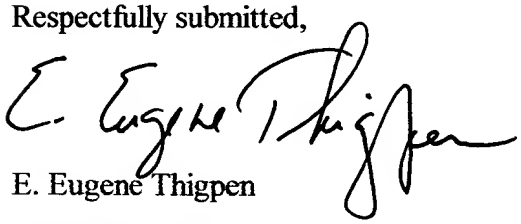
The invention fulfills a need for an improved system for organizing, storing and displaying seismic information to assist in the analysis and interpretation of the subsurface structure and geology. As stated on page 28, lines 6 - 12, of the application, "The availability of a geologic time volume during the seismic data interpretation process may result in a more detailed, complete and internally consistent interpretation. Further, generating a geologic time volume for existing interpretations may indicate errors in those interpretations where the implied geologic time

decreases with depth (travel time) to areas where thrust faulting and overturned beds are not expected. Anomalous changes in geologic time versus travel time may also indicate interpretation problems or unique depositional or compaction environments."

A unique aspect of one embodiment of the invention is the recognition that the unwrapped phase is related to geologic time. In a normal seismic section, (one without reverse faults or overturned beds) unwrapped phase will increase with travel time, and a constant phase will follow a surface of constant geologic time. Accordingly, in a 3D volume, a surface of constant unwrapped phase will normally coincide with a surface of constant geologic time.

In view of the foregoing amendments and remarks, reconsideration and allowance of the pending claims is respectfully requested. The invention as defined in the claims is neither anticipated nor obvious in view of the cited references, either alone or in combination. A Notice of Allowance is respectfully requested.

Respectfully submitted,



E. Eugene Thigpen
Registration No. 27,400

P.O. Box 42427
Houston, Texas 77242

Tel: (713) 266-2017
Fax: (713-266-2017